UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/782,446	02/12/2001	Chok W. Ho	LAM1P152/P0692	9868

22434 7590 08/06/2003

BEYER WEAVER & THOMAS LLP
P.O. BOX 778
BERKELEY, CA 94704-0778

EXAMINER
VINH, LAN

ART UNIT	PAPER NUMBER
1765	14

DATE MAILED: 08/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Application No.	Applicant(s)
09/782 446	HO ET AL
Examiner	**Art Unit**
Lan Vinh	1765

Office Action Summary

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 July 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4,5,7-9,11,13,20-22 and 24-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *4,5,7-9,11,13,20-22, 24-26,33-34* is/are rejected.

7)☒ Claim(s) *27-32* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent. or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

2. Claim 4 is rejected under 35 U.S.C. 102(e) as being anticipated by Ye et al (US 6,080, 529)

Ye discloses a method of etching patterned dielectric layer. This method comprises the steps of:

forming a hard mask layer 222 over the organic low k dielectric layer 220 (polyarylene) (col 11, lines 44-49, col 19, lines 52-53)

forming/placing a patterned photoresist layer 224 over the hard mask layer 222 (col 11, lines 52-54),

placing a substrate having an organic low k dielectric layer 220 (polyarylene) formed thereon in an etching chamber (col 12, lines 1-5)

using a plasma source gas of hydrogen/nitrogen-based plasma (NH_3) inherently provided into the etching chamber while applying source power to the chamber to generate a plasma to etch the organic low k dielectric layer 220, the etch selectivity of the materials is such that layer 222 etches more rapidly than layer 220 (col 12, lines 10-

62), the flow rate of NH_3 is 70 sccm (col 22, lines 42), which overlaps the claimed range of 5 sccm to 1500 sccm

etching the unpatterned photoresist in an NH_3 (hydrogen/nitrogen-based) plasma and Ye also discloses that hydrogen/nitrogen-based etch chemistry etches both photoresist and organic-based layer (col 12, lines 49-51; col 22, lines 38-42), which reads on simultaneously etching/stripping the photoresist layer during etching of the organic dielectric layer

3. Claims 4, 11, 13, 20, 22, 25, 26, 33, 34 are rejected under 35 U.S.C. 102(e) as being anticipated by Kadomura et al (US 6,352,937)

Kadomura discloses a method for stripping organic based film over a substrate comprises the steps of:

forming/placing a silicon nitride layer 2 over the organic dielectric layer 3a (col 3, lines 54-56), which reads on placing a hard mask over the organic dielectric layer

forming/placing a patterned organic film 4 of resist over layer 2/hard mask (col 3, lines 59-60)

placing the substrate in a stripping vessel/etching chamber (col 4, lines 46-47)

providing an etchant composed of NH_3 (ammonia) into the chamber, the ammonia has a flow rate of 100 sccm (overlaps the claimed ranges) (col 6, lines 18-38), generating a plasma from the ammonia by providing power and pressure into the chamber to etch the organic layer 3a and layer 2/hard mask layer (col 6, lines 49-51). Since Kadomura teaches the same method of etching different materials in the same

structured (a hard mask/silicon nitride over the organic dielectric layer/polymer) using the same etchant (ammonia) as the claimed invention. Kadomura' s plasma from the ammonia inherently selectively etches the organic dielectric layer with respect to the hard mask

stripping the resist film 4 with radical generated in the gas composed of ammonia (col 6, lines 10-12), which reads on simultaneously stripping the photoresist layer during the etching of the organic dielectric layer

Regarding claims 11, 33, Kadomura discloses that the resist layer 4 is completely stripped (col 7, lines 3-5)

The limitation of claim 20 has been discussed above.

Regarding claim 22, Kadomura discloses that the temperature of the wafer/substrate is 25^0 C (col 7, lines 46-48), which overlaps the claimed ranges

Regarding claims 25, 26, Kadomura is silent about the use of bias power which reads on providing a bias power of about 0 W

Regarding claim 34, Kadomura discloses using the gas mainly composed of ammonia (col 6, lines 18-20)

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claim 5 is rejected under 35 U.S.C.103(a) as being unpatentable over Kadomura et al (US 6,352,937) in view of Ding et al (US 5,814,563)

Kadomura's method has been described above in paragraph 3. Unlike the instant claimed invention as per claim 5. Kadomura fails to disclose providing CH_3F gas (flow rate between 1 sccm –50 sccm) while providing NH_3 into the chamber to etch the dielectric layer.

However, Ding, in a method for etching dielectric layer using fluorocarbons, teaches flowing CH_3F gas (flow rate between 5 sccm-20 sccm) and NH_3 gas into the chamber to etch the dielectric layer (col 10, lines 26-27)

Hence, one skilled in the art would have found it obvious to modify Kadomura's step of etching the dielectric layer by using an etching mixture of CH_3F gas and NH_3 to etch the dielectric layer as per Ding because Ding teaches that it has been discovered that fluorohydrocarbons gas in combination with NH_3-generation gas provides unexpected and surprising results such as providing increased dielectric etch rate (col 6, lines 14-18)

6. Claim 7-9 rejected under 35 U.S.C.103(a) as being unpatentable over Kadomura et al (US 6,352,937) in view of Ding et al (US 5,814,563) and further in view of Ye et al (US 6080,529)

Kadomura as modified by Ding has been described above. Unlike the instant claimed inventions as per claims 8, 9. Kadomura and Ding fail to disclose providing CF_4 and oxygen prior to the step of providing ammonia gas.

However, Ye discloses a method of etching patterned layer comprises the step of etching a dielectric layer using CF_4 and CHF_3 and oxygen prior to the step of providing NH_3 (col 22, lines 5-40.)

Since Kadomura is concerned with a step of etching a via using fluorocabon and oxygen (col 5, lines 54-57, fig. 2), one skilled in the art would have found it obvious to modify Kadomura and Ding by adding the step of providing CF_4 and oxygen prior to the step of providing ammonia gas as per Ye because according to Ye the etch chemistry of CF_4 and CHF_3 and oxygen provide nearly straight sidewalls on the etched via (col 22, lines 24-25)

7. Claims 21, 24 are rejected under 35 U.S.C.103(a) as being unpatentable over Kadomura et al (US 6,352,937) in view of Guinn et al (US 5,877,032)

Kadomura discloses a method for stripping organic based film over a substrate comprises the steps of:

placing the substrate in a stripping vessel/etching chamber (col 4, lines 46-47)

providing an etchant composed of NH_3 (ammonia) into the chamber, the ammonia has a flow rate of 100 sccm (col 6, lines 18-38), generating a plasma from the ammonia by providing power and pressure into the chamber to etch the organic layer 3a and layer 2/hard mask layer (col 6, lines 49-51)

maintaining the temperature of the wafer/substrate is 25^0 C during the etching (col 7, lines 46-48), which overlaps the claimed ranges

Unlike the instant claimed invention as per claims 21, 24, Kadomura fails to disclose the specific values of the flow rate of NH_3

However, Guinn, in a process for plasma etch, teaches that plasma etch processing parameters such as temperature, flow rate are selected for variation to change the etch rate (col 4, lines 1-6)

Hence, one skilled in the art would have found it obvious to vary/adjust Kadomura's NH_3 flow rate to discover the optimum values of the flow rate by conducting routine experimentation in view of Guinn's teaching in order to achieve a desired etch rate.

Allowable Subject Matter

8. Claims 27-32 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 27, the cited prior art of record fails to disclose or suggest the step of placing a second organic low-k dielectric over the etch stop layer formed over an organic low-k dielectric layer, wherein the second organic low-k dielectric layer is between an organic low-k dielectric layer and the hardmask. The closest cited prior art of Kadomura et al (US 6,352,937) discloses forming an hardmask 2 between a second organic low-k dielectric 3b and an organic low-k dielectric layer 3a.

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Zhao et al (US 6,245,663) discloses that etch selectivity is achieved between silicon nitride and organic low-k dielectric layer (col 9, lines 40-43)

Response to Arguments

10. Applicant's arguments with respect to the Ye reference have been fully considered but they are not persuasive. Applicants argue that Ye (US 6,080, 529) fails to teach using an ammonia etchant to selectively etch an organic low-k dielectric with respect to a hard mask layer. This argument is unpersuasive because as recited in (col 12, lines 10-62) of Ye, Ye discloses using a plasma source gas of hydrogen/nitrogen-based plasma (NH_3) inherently provided into the etching chamber while applying source power to the chamber to generate a plasma to etch the organic low k dielectric layer 220, the etch selectivity of the materials is such that layer 222 etches more rapidly than layer 220. Thus, the examiner asserts that claim 4 is anticipated by Ye (529).

Applicant's arguments with respect to claims 5, 7, 11, 13, 20-22 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703 305-2667. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308-0661.

LV
August 4, 2003